MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

EEM1026 – ENGINEERING MATHEMATICS II

(ME/ TE/ RE)

22 OCTOBER 2019

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT:

1. This exam paper consists of 4 **pages** (including cover page) with 4 Questions only.

2. Attempt all the questions. All questions carry equal marks and the distribution of marks for each question is given.

2. Please write all your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.

3. Only NON-PROGRAMMABLE calculator is allowed.

Question 1

(a) By using the method of undetermined coefficients, solve the following inhomogeneous differential equation.

$$y''-4y'+3y=6e^{2x}+10e^{3x}$$

[12 marks]

(b) Consider the solution of $\frac{dy}{dx}+(2-5x)y=0$ in the form of power series in x about $x_0=0$, i.e., $y=\sum_{n=0}^{\infty}c_n x^n$. Find the first four nonzero terms of this series solution. [13 marks]

Question 2

(a) The average age of students in Rieman college is 26 years with a standard deviation of 4 years. Find the probability that the mean age for a random sample of 36 students would be between 25 and 27 years. [7 marks]

(b) The average zinc concentration recovered from a sample of measurements taken in 36 different locations in a river is found to be 2.6 grams per milliliter. Find the 99% confidence interval for the mean zinc concentration in the river. Assume that the population standard deviation is 0.3 gram per milliliter. [6 marks]

(c) A past study claims that adults in city A spend an average of 18 hours on leisure activities per week. Recently, a researcher took a sample of 10 adults from city A and recorded their responds to amount of time (hours) they spend per week on leisure activities which is given as below:

14 25 22 38 16 26 19 23 41 33

Assume that the time spent on leisure activities by all adults is normally distributed. Using the 5% significance level, can you conclude that the average time spent on leisure activity is still the same (18 hours)? [12 marks]

Continued...

Question 3

(a) Set up the initial value problem for the vibration of an infinite string. Initial displacement of the string is $\cos x$ and the initial velocity is $2x$. [6 marks]

(b) Hence, solve (a) by using the D'Alembert's solution. Simplify your answer. [9 marks]

(c) Consider the Laplace equation: PDE : $u_{xx} + u_{yy} = 0$ for $0 \le x \le a, 0 \le y \le b$. Find all possible solutions for Case *i*: $\lambda = p^2$, Case *ii*: $\lambda = -p^2$ and Case *iii*: $\lambda = 0$. [10 marks]

Question 4

(a) Find the fourier cosine transform of $f(x) = \begin{cases} -1, & 0 \le x \le 1 \\ 1, & 1 < x \le 2 \\ 0, & otherwise \end{cases}$ [6 marks]

[Hint: Formula of Fourier cosine transform is $F_c(w) = \sqrt{\dfrac{2}{\pi}} \int_0^\infty f(x) \cos \omega x \, dx$]

(b) Find the Fourier transform of

$$f(x) = \begin{cases} e^{ix}, & -1 < x < 1 \\ 0 & otherwise \end{cases}$$ [6 marks]

[Hint: Formula of Fourier transform is $F(w) = \dfrac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(x) e^{-i\omega x} dx$]

(b) Solve the following initial-value problem by Laplace transform.

$y'' + 8y' + 16y = 8e^{-2t}$, $y(0) = 2$ and $y'(0) = 0$. [13 marks]

Continued...

APPENDIX

Table I: Laplace transform for some of function $f(t)$

$f(t)$	$F(s) = \mathcal{L}\{f(t)\}$
1	$1/s$
t	$1/s^2$
$t^n (n = 1, 2, 3, \ldots)$	$n!/s^{n+1}$
e^{at}	$\frac{1}{s-a}$
te^{at}	$\frac{1}{(s-a)^2}$
$t^{n-1}e^{at}$	$\frac{(n-1)!}{(s-a)^n}$, $n = 1,2,\ldots\ldots$
$\cos at$	$\frac{s}{s^2+a^2}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$u(t - a)$	$\frac{e^{-as}}{s}$, $a \geq 0$
$f(t - a)\, u(t - a)$	$e^{-as} L(f)$
$f(t)\, \delta(t - a)$	$e^{-as} f(a)$
$f'(t)$	$s\mathcal{L}(f) - f(0)$
$f''(t)$	$s^2\mathcal{L}(f) - sf(0) - f'(0)$

End of paper.